Bomb Bin

This invention relates to bomb bins for protecting nearby structures against the effects of an explosion.

It is well known to use water to mitigate against the effects of an explosion and, for example, EP 0276918 describes various forms of inflatable structures which may be placed over and around a bomb in order to mitigate against the effects of any subsequent explosion. This concept is taken a further step by the use of drop stitch material as taught in GB 2374625, the disclosure of which is incorporated herein by reference, the drop stitch material allowing protective walls to be erected quickly which are taller than the width of the base and which may initially be filled with air to attain their desired shape, followed by water to mitigate against any subsequent blast.

It is further known from a paper by Messrs Keenan and Wager dating from 1992 at the 25th DoD Explosives Safety Seminar at Anaheim, California, that where water is allowed to aerosolise by being located at or near the proximity of a subsequent explosion the aerosolised water prevents combustion of detonation products by preventing access to oxygen and by cooling gases below the temperature required to sustain combustion. They also found that vaporisation of water absorbs 539 calories/gram plus 1 calorie/gram/degree to heat the water to 100°C, thereby concluding that aerosolised water can absorb all of the detonation energy of explosive if the weight ratio of water to explosive is 930/539 i.e. 1.8 for TNT explosive and 3.8 for H-6 explosive. Tests they conducted concluded that the peak gas pressure and total gas impulse present can be lowered by as much as 90% than in the case of the corresponding peak

gas pressure and total gas impulse in the absence of water. They also found that providing 2.89lbs of water for each pound of TNT explosive reduced the peak gas pressure from 51.1lbs per sq inch to just 5.85 lbs per sq inch for a total reduction therefor of nearly 90%. They therefore proposed various configurations for use in and around military installations including a transportable bomb cart, being a reinforced container and associated lid into which may be placed e.g. an explosive device and around which may be suspended water filled rupturable containers which permitted the water to be aerosolised in the event of an explosion, thereby reducing the effects of the explosion accordingly.

This concept is refined further in the teaching of GB 2 289 750 issued to Parkes in which unwanted munitions can be effectively disposed of by arranging for lay flat plastic tubing filled with water to be draped over rigid supports such that separated volumes of water and air are present in a line away from the intended source of a blast when the munitions are detonated through the use of a control charge.

A problem with the foregoing prior art apparatus and methods is that the weight of water constitutes a significant disadvantage where e.g. a terrorist device has to be dealt with, especially on airborne vehicles such as passenger planes. A "worst case" scenario is that a bomb is discovered in e.g. the heel of the shoe of a suicide bomber which may or may not detonate prior to the plane landing or descending to a height at which the device may be safely jettisoned.

The present invention is derived from the surprising realisation that many aircraft, including passenger aircraft, have reasonably substantial quantities of

water or other liquids on board for use in galleys and on board toilets which could be diverted to a stowed blast mitigation bin into which the device may be put to thereafter mitigate against the effects of any subsequent explosion before the plane has landed.

According to the invention there is provided a water fillable blast suppression bin comprising an inflatable container for holding e.g. a bomb, the container comprising an outer layer of ballistic-grade material acting as a last line of containment for a subsequent blast, one or more internal layers for forming containers for holding water and/or gas and/or material layers to provide separated volumes of water and/or gas, such as nitrogen, in use, and/or fibrous material, such as mineral wool, and closure means, such as a lid, also having an outer layer of ballistic-grade material and one or more layers of water and/or gas fillable containers and/or fibrous material.

Conveniently, the gas may be nitrogen and may be contained in individual fillable polythene bags from e.g. a nitrogen containing cylinder under pressure.

Conveniently, the blast suppression bin has, when filled, volumes of gas such as nitrogen contained in e.g. individual polythene bags placed around a suspect device, followed by a layer of water in a fillable container, such as made of drop stitch material, followed by a layer of gas, such as nitrogen, followed by a final layer of water adjacent the ballistics grade outer layer. Alternatively, in place of one or more layers of gas or water one or more layers of fibrous material, such as mineral wool, may be used to progressively dampen the effects of an explosion to hopefully contain it wholly or substantially wholly within the blast suppression bin, at least to the extent that the detonation does not

cause structural damage to a vehicle in which it is used, such as an aeroplane.

Preferably, the blast bin includes an inner container for containing water which is separated from an outer container for containing water by an intermediate container for containing a gas which thereby allows water in the inner container to be completely or substantially completely aerosolised upon an explosion occurring within the bin to thereby reduce the peak gas pressure and total gas impulse of the shockwave before it reaches the outer container.

The blast suppression bin may be substantially cylindrical in shape having a closed end intended for placement on a flat surface such as a floor and an open end into which a suspect device may be placed, with closure means in the form of a lid overlaying and sealing the otherwise open end.

In a further embodiment the blast suppression bin is substantially spherical (or alternatively circular on at least one axis) when inflated and includes an inner container for holding a suspect device, the inner container preferably having opposing walls fillable therebetween with water and most preferably being secured to but spaced from the inside wall of a correspondingly shaped outer container, itself fillable with water so as to create a water/gas/water structure when the bin is inflated. Conveniently the inner and outer containers may be provided with closure means in the form of openable pocket-like slits permitting insertion and placement of a suspect device into the inner container either before or after inflation of the bin, which slits may also be provided with temporary closure means, such as zips or opposing strips of releaseable hook fasteners such as Velcro®. In addition, for placement of the bin centrally within e.g. the fuselage of an aircraft means may be provided, such

hooks and/or eyes, for suspending it off the floor.

Conveniently, a water inlet conduit may be supplied to the inner container and a further conduit may be provided for then filling the inside of the outer container, or alternatively separate conduits may be provided for such purposes.

The invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a part perspective view of a first embodiment of blast suppression bin according to the invention,

Figure 2 is a part perspective view of a preferred embodiment of blast suppression bin according to the invention,

Figure 3 is an exploded perspective view of an alternative embodiment of blast suppression bin,

Figure 4 is a sectional view taken from the front of the bin of Figure 3, and

Figure 5 is a sectional view of a further alternative blast suppression bin according to the invention.

Referring firstly to Figure 1 there is shown a part cutaway view of a first embodiment of blast suppression bin shown generally at 1 with the front wall removed for clarity, the blast bin comprising a container portion 2 and closure means in the form of a lid portion 3 (shown raised for clarity) which may be strapped to the container portion 2 by straps (not shown) of e.g. reinforced ballistics-grade webbing material (e.g. nylon, Kevlar or zylon) such that in the event of detonation of e.g. a TNT bomb, as shown, the lid 3 tends to remain in position attached to the container portion 2 in use.

When assembled together the blast suppression bin 1 has outer walls 4

comprising or including ballistics grade fabric, to act as a last line of containment for a blast. In order to inhibit the effects of an explosion from e.g. a TNT bomb internal walls of the container 2 are made of drop stitch or similar material by which separated volumes of water/gas or fibrous material, such as mineral wool, may be constructed. In the subject example the outer container 6 may initially be inflated with air to assume its generally cuboid shape and then the air replaced with water piped in from elsewhere, such as a suitable water pipe from within the body of an aircraft. The inner container 7 may simply be filled with e.g. mineral wool which is known to suppress the effects of e.g. a blast from an explosive device, including shrapnel or "fly" and, similarly, the device itself may be surrounded by gas filled polythene bags 8, preferably nitrogen filled (or some other inert gas), placed around the TNT charge so that it is held in the middle of the blast suppression bin 1.

In the event of the TNT exploding it will be appreciated that the presence of e.g. nitrogen in its immediate surroundings helps to prevent or inhibit ignition and the presence of the mineral wool 7 can help to soften the impact of and catch any flying debris, whereafter the presence of the water filled container 6 allows the water to absorb some of the shock of the explosion, and finally the ballistic grade outer covering 4 may completely, or at least sufficiently, mitigate against the effect of the explosion such that it is insufficient to cause catastrophic consequences to e.g. the structure of the vehicle in which it is carried.

Turning now to the embodiment shown in Figure 2, where like parts are given like numbers, this takes advantage of the principles discussed in the

Keenan and Wager prior art and later prior art in that it teaches that it is preferable to ensure that water placed next to a charge is immediately aerosolised, as discussed above in the preamble hereto, by providing a relatively small volume of water next to e.g. a TNT bomb so as to maximise the chances of it being completely aerosolised before the shock wave carries on through the remaining part of the structure. This can be achieved by having a relatively thin inner container 9, again typically made of drop stitch material, which can be filled with water and between which is an intermediate container 10 which may simply be filled with a gas such as nitrogen or even air such that in combination with the outer container 6 being filled with water the shock wave, for example, first passes through a small amount of water which is completely aerosolised, then through the gas and then through a larger mass of water in the outer container 6 before the shock wave hits the outer walls 4 of ballistics grade material.

In order to ensure that the explosive charge is placed as centrally as possible within the blast suppression bin a plinth 11 may be provided, although it will be appreciated that other forms of support may be used and in particular supports which allow the shock wave from detonation to hit the water in the first container 9 in an unimpeded manner so as to maximise the chances of complete aerosolisation of that water. The plinth 11 may be made of e.g. a rigid plastics support frame so as to ensure as far as possible that aerosolisation is generally spherical and is not biased in any particular direction. Alternatively, filled bags of gas, such as nitrogen, may be placed around the support device in the manner as shown in Figure 1.

In a further refinement the blast mitigation bin includes its own charge of compressed gas in a gas cylinder (not shown) so that it may be immediately available for initially inflating the containers, which is then replaced with water via the use of one or more pressure relief valves. The or each pressure relief valve may be configured to vent gas, such as nitrogen or carbon dioxide, into the interior of the bomb bin so as to mitigate against ignition of detonation products immediately after an explosion. In a still further refinement the bomb bin is storable in its deflated condition and is pre-connected or connectable to a hose for liquid, such as water from the galley of a passenger plane, so that the hose can be deployed quickly and connected to the main water system in the plane. In a still further refinement the water-fillable inner container, where fitted, is adapted to be filled first so that in the event the outer water fillable container has not been filled at the time an explosion occurs the inner layer of water is used most efficiently by being aerosolised, so as to minimise the strength of the resulting shock wave.

Turning now to Figures 3 and 4, there is shown a further embodiment of blast suppression bin 12 comprising a cylindrical lower container portion 13 having a closed end 14 for resting on a flat surface such as the deck of an aircraft, and an open end 15 into which a suspect device may be placed and which may thereafter be closed by means of a correspondingly shaped lid 16 having an internal diameter slightly larger than the external diameter of the lower container portion 13. The outside of the outer container 17 includes ballistic grade material (not shown) to act as a last line of containment for an explosion.

As with the embodiments of Figures 1 and 2, the lower portion 13

includes a water-fillable outer container 17, an intermediate container 18 and an inner container 19. Inner container 19 is preferably fillable with water but may instead be filled with e.g. an inert gas such as nitrogen, or a fibrous fabric material designed to catch shrapnel or "fly" following an explosion of the suspect device. Alternatively, the intermediate container 18 may instead simply be filled with an inert gas such as nitrogen with the inner container being filled or fillable with water 19, thereby providing a water/gas/water barrier for the explosive to, initially, aerosolise the water in the inner container 19, the gas within the intermediate container 18 allowing room for this to happen, whereafter the shock wave is further suppressed by the water in the outer container 17.

Similarly, the lid 16 includes an outer container 20, and intermediate container 21 and an inner container 22, which may be fillable in the same order as the container portion 13 and may conveniently be pneumatically connected therewith or may be separately inflatable.

In the embodiment shown in Figures 3 and 4, construction of the blast suppression bin 12 particularly suits the use of dropstitch material, which is usually constructed as a flat hollow sheet having opposing side walls connected by fibrous webs so that when inflated the fibrous webs help to retain the desired shape. As will be apparent from the drawings, to construct e.g. the lower container portion 13 it is simply necessary to cut three respective lengths of dropstitch sheet material which are each then joined end-on-end to make the side walls of the container 17, 18 and 19. To form the closed end of each container 17, 18 and 19, the dropstitch sheeting can be cut into circles corresponding with the required diameter, whereafter each such circle is

secured to its respective container by e.g. welding or adhesive.

Turning now to Figure 5, there is shown a cross-sectional view of a further embodiment of invention in which the inflatable blast suppression bin 23 this time takes the form of a generally spherical container 23 when inflated as shown, although it will be understood that other forms of circular but not strictly spherical containers could be used instead, such as circular on one axis but oval on an axis normal thereto.

The blast suppression bin 23 comprises a hollow outer container 24 and a hollow inner container 25 supported, in use, by radially extending webs or lines 26 connecting the inner wall 27 of the outer container 24 with the outer wall 28 of the inner container 25 so as to afford a gap therebetween permitting initial aerosolisation of a liquid such as water in the walls of the inner container 25 before the shock wave of an explosion encounters the water within the outer container 24. The containers 24, 25 may be made of dropstitch material so as to keep their intended shape when inflated, although other ways of achieving this objective may be employed including through the use of internal webbing or the external welding together of opposing container walls, if made of e.g. plastics materials. The outer container 24 also includes as outer layer of ballistic grade material (not shown) acting as a last line of containment in the event of an explosion.

In order to gain access to the inside of the blast suppression bin 23 for placing e.g. a suspect device in the centre thereof, pneumatically sealed pocket-like slits 29, 30 are provided through the walls of the containers 24, 25, of length sufficient only to allow for placement of a device within the centre of the

container 25 by folding the leading edges of these slits 29, 30 in the directions shown arrowed, which slits may thereafter be releasably closed through the use of e.g. zips or strips of releaseable hook fasteners such as Velcro® secured to opposing sides of the containers 24, 25 in these regions. The embodiment of Figure 5 also includes a water inlet valve 31 which is pneumatically connected to a conduit 32 allowing for the inflow of water under pressure to thereafter initially fill the container 25 in the manner as shown. A pressure relief valve 33 at the end of an outlet conduit 34 then allows water to flow in the direction arrowed into the outer container 24 until it is fully inflated in the manner as shown. Alternatively, the conduit 34 may be omitted and the conduit 32 may instead allow for filling of the outer container 24 substantially at the same time as the inner container 25.

Eyelets 35 may be positioned around the outer container 24 for the purposes of securing it by e.g. rope or webbing above the floor so that any subsequent explosion occurs when the bin 23 and explosive device have been mounted in the strategically safest position, such as in the middle of the fuselage of an aeroplane.